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(54) A DRIVE TRANSMISSION DEVICE

(71) We, P. B. BETTINSON & COMPANY LIMITED of Holbeach, Lincolnshire PE12 7LS, a British company do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The present invention provides a machine comprising two drive members and a transmission device releasably attached to said machine and arranged to transmit power between said drive members, said transmission device comprising a housing, a series of at least two rotary elements mounted in said housing on a pitch circle about one of said drive members and interconnected for simultaneous rotation together, both said drive members being disposed at one side of the housing but with said one drive member extending through said housing from said one side to the other side of said housing, a drive means engaged with said one drive member at said other side of said housing, said drive means being rotatably mounted at said other side of said housing for movement relative to said housing about said one drive member for engagement with any one of at least two of said rotary elements, said housing with said rotary elements being rotatable relative to the other of said drive members about said one drive member for the engagement of any one of at least two of said rotary elements with said other drive member at said one side of said housing, at least one of said rotary elements being engagable with said drive means and with said other drive member.

Preferably said rotary elements are mounted in said housing for rotation about axes parallel to one another and passing through said pitch circle, said other drive member being mounted for rotation about an axis parallel to said axes of rotation of said rotary elements and passing through said pitch circle.

The drive means may comprise two rotary members interconnected for simultaneous rotation together.

By the term "rotary element" and "rotary member", as used herein, are meant wheels or the like, and the terms include gear wheels, sprockets, pulleys or plain edged wheels capable of frictional engagement with other such wheels. The type of rotary element or member used in any particular embodiment of the transmission devices of the invention will depend upon the materials employed and the torque requirements of the machinery with which the device is associated. Thus for low torque systems frictional engagement using pulleys connected by belts, or direct frictional engagement of the rotary elements or members one with another or through idling members would be suitable. For systems where medium torque is encountered chain driven sprockets may be more suitable, whilst for high torque systems conventional gears may be used, meshing either directly with one another or through idling members interposed between them.

A transmission device according to the invention may be used in different sorts of machinery to provide a wide variety of output speeds from any given input speed. Thus it may be used to transmit the drive from an internal — combustion or electric motor to the road wheels of a vehicle, or it may be used to provide a variety of operating speeds for fixed machinery, for example mixers, textile machinery, callendering machinery and scientific apparatus of various kinds. One particular use of a transmission device according to the invention is to provide a drive from a ground wheel to a pair of contra-rotating rollers in a seed drill. In this application such a device gives great flexibility to the way in which the rate of seeding may be varied according to the type of seed to be distributed.

Embodiments of the invention will now be described by way of example, with reference to the accompanying drawings in which:

Figure 1 is a front view of one embodiment of transmission device according to the present invention.

Figure 2 is a sectional view on the line II—II on Figure 1 and shows part of a machine to which the device is attached,

Figure 3 is a sectional view on the line III—III on Figure 2,

Figure 4 is a sectional view on the line IV—IV on Figure 2,

Figure 5 is a front view of a different embodiment of transmission device according to the present invention,

Figure 6 is a sectional view on the line VI—VI on Figure 5 and shows part of a machine to which the transmission device is attached (for simplicity the device is shown without the chains of the chain drive inter-connections),

Figure 7 is a sectional view on the line VII—VII on Figure 6, and

Figure 8 is sectional view on the line VIII—VIII on Figure 6.

The transmission device shown in Figures 1 to 4 of the accompanying drawings comprises a housing 10. Mounted in the housing 10 are seven rotary elements in the form of spur gear wheels 11 to 17 interconnected together for simultaneous rotation together by the meshing of their gear teeth. Each of the spur gear wheels 11 to 17 have axial trunnions 18 mounted in bearings 19 provided in the walls of the housing 10.

As shown in Figure 2 the transmission device is to be attached to a machine 20 having two drive members 21 and 22 in the form of shafts the axes of rotation of which are parallel to one another. The rotary elements 11 to 17 are mounted in the housing with their axes parallel to one another and extending through a pitch circle along which the rotary elements are disposed. The housing 10 has a bearing 23 in which is journalled a circular cross-section shaped portion 24 of a shaft of the one drive member 21, the axis of rotation of the one drive member 21 being coincident with the axis of the pitch circle. The radius of the pitch circle is equal to the distance between the axes of rotation of two drive members 21, 22 and thus the rotary elements and the housing are movable about the axis of the pitch circle and thus of the one drive member 21 relative to the other drive member 22 for the engagement of the drive member 22 with a selected one of the rotary elements 11 to 17.

Each of the rotary elements, in the form of gear wheels and their trunnions 18, is formed with an axial hole of hexagonal cross-section to receive and be non-rotatably engaged by a portion 25 of the shaft of the other drive member 22 which is of complementary hexagonal cross-sectional shape. As shown in the drawings the shaft of the other drive member is engaged in rotary element 15. The cross-sectional shape of the housing 10 transverse to the axis of the drive members 21, 22 and the rotary elements 11 to 17 is circular.

A drive means 26 comprises two rotary members 27 and 28 in the form of two spur gear wheels mounted in a casing 29 for rotation about parallel axes with their gear teeth in mesh so that they are inter-connected for simultaneous rotation together. Each of the gear wheels 27, 28 has axial trunnions 30 mounted in bearings 31 in the walls of the casing 29. The distance between the axes of rotation of the rotary members 27, 28 is equal to the distance between the axes of the drive members 21, 22 and thus to the radius of the pitch circle along which rotary elements are disposed. Each of the rotary members 27, 28 and their trunnions 30 are formed with an axial hole of hexagonal cross-sectional shape. These holes in rotary members 27, 28 have the same shape and dimensions as each other and as the holes in the rotary elements 11 to 17.

The one drive member 21 has a shaft portion 32 of hexagonal cross-sectional shape complementary to that of holes in the rotary members 27, 28. The one rotary member 27 is received on shaft portion 32 which extends beyond the housing 10 and is non-rotatably engaged on shaft portion 32.

A shaft member 33 has a hexagonal cross-sectional shape complementary to that of the holes in the rotary elements and members and has a circumferential locating flange 36 midway along its length. The shaft member 33 is arranged with substantially half of its length in the hole in rotary member 28 and the other half in the hole in a selected one of the rotary elements 11 to 17 although in the selected arrangement shown in the drawings it is engaged in rotary element 12. Thus the shaft member 33 connects non-rotatably the other rotary member 28 and that selected one of the rotary elements 11 to 17. As the shaft of the other drive member 22' is arranged to extend into the selected one of the rotary elements 11 to 17 only up half the axial length of that element it is possible for the shaft member 33 to be engaged in the same rotary element as shaft 22 at the same time.

The housing 10 and casing 29 are attached to the machine 20 simply by means of a washer 34 on shaft portion 32 and a transverse pin 35.

The diameter of and number of gear teeth on rotary member 27 are greater than those on the rotary member 28 and thus the members 27, 28 rotate at different speeds. As their axial holes are of the same shape and dimensions their positions may be interchanged the one for the other by removal, reversal and replacement of the casing 29 on the housing of the device.

Similarly the casing together with its gear members can be removed entirely and replaced by another drive means having rotary members of a different speed ratio.

The drive means 26 is movable about the axis of the one drive member 21 after it has been partially withdrawn along the shaft portion 32 with the shaft member 33 for the engagement of the drive means 26 with a selected one of the rotary elements 11 to 17. The housing 10 together with the drive means 26 is movable about the axis of the one drive member 21 after it has been partially withdrawn along the shaft portion 24 of the drive member 21 for the engagement of a selected one of the rotary elements with the shaft of the other drive member 22, the housing 10 being rotated on the shaft portion 24.

The rotary elements 11 to 17 and the rotary members 27, 28 are formed from nylon or a similar plastics material.

A large number of input/output speed ratios are provided for the transmission of power between the two drive members 21, 22, and as indicated earlier a number of drive means differing in the speed ratios of their rotary members can be provided to extend the range of speed ratios between drive members 21, 22 further.

With shaft 22 engaged in rotary elements 15 and with shaft member 33 engaged in rotary element 12, the device transmits power when the one drive member 21 is driven as an input to the device, through rotary members 27, 28 of the drive means 26 to the rotary element 15 through the shaft member 33 and then via the rotary elements 13 and 14 to rotary element 15, the drive then being transmitted to the shaft 22 of the other drive member. Of course, drive can be transmitted when drive member 22 is the input drive member to the device.

The housing 10 and the casing 29 are of two-part construction the junction between the two parts of each being transverse to the axis of the one drive member.

The transmission device shown in Figures 5 to 8 of the drawings comprises a two-part housing 40 each part of which is internally formed to provide support for the free rotation of shafts 43, 44, 45, 46, 47, 48 which support and to which are non-rotatably secured a series of rotary elements in the form of chain sprockets 49, 50, 51, 52, 53, 54, 55. Three sprockets 50, 51, 55, are in one plane and the other four, 49, 52, 53, 54 are in a second plane, each group of sprockets being linked together by a chain drive 56, 57 respectively. Since two sprockets 54, 55 share a common shaft 48 all the sprockets are interconnected for simultaneous rotation together. The sprockets are arranged to rotate about axes parallel to one another and extending through a pitch circle. The chain drives 56, 57 are tensioned through the idlers 58, 59 respectively which are fixed to the housing 40. The housing 40 also provides support on the axis of the pitch circle for the free rotation of one drive member in the form of shaft 60 of a machine to which the device is to be attached. The axis of rotation of the one drive member is coincident with that of the pitch circle. A sprocket 61 is mounted non-rotatable on the shaft 60. A mounting support comprises a boss 62 on the housing 40 which co-operates with and is rotatable in a collar 63 on the machine the boss having a circumferential annular groove 64 enabling the main assembly to be releasably fixed in the collar 63 by means of a sprung key 65. When fixed in this way a squared end of a selected one of the shafts 43 to 48, (as shown in the drawings, it is shaft 45) fits for a non-rotatable engagement into a correspondingly shaped recess in the end of another drive member in the form of a shaft 66 which bears a sprocket 67. The axes of rotation of drive members 60, 66 are parallel to each other and spaced apart by a distance equal to the radius of the pitch circle, the axis of rotation of the other drive member 66 extending through the pitch circle. The housing 40 and the rotary elements 49 to 55 are rotatably movable about the axis of the pitch circle, and thus about the axis of rotation of the one drive member relative to the other drive member 66 for the engagement of the other drive member 66 with the selected one of the rotary elements. Each of the shafts 43 to 48 and the shaft 60 also project through the housing on the side which is distant from the boss 62 for co-operation with a drive means 73. This drive means 73 consists of two rotary members in the form of sprockets 68, 69 linked by a chain drive 70 for simultaneous rotation together, each sprocket being mounted on a hollow shaft 71, 72 respectively the ends of which are journalled into a two-part housing 74 of the drive means 73. The axes of rotation of shafts 71, 72 are parallel to each other and are spaced apart by a distance equal to that between the axes of drive members 60, 66 and the radius of the pitch circle. When functionally connected to the housing 40 the protruding end of a selected one of the shafts 43 to 48, as shown in the drawings shaft 43, and the shaft 60 of the one drive member are received within the hollow shafts 72, 71 respectively and fixed in place by means of transverse pins 76, 75. The drive means 73 is movable about the axis of the pitch circle for the engagement of the drive means with the selected one of the rotary elements.

Considering the device arranged as shown in the drawings, in operation, a drive is

applied to the one drive member, shaft 60 through the sprocket 61 and is transmitted through the device to the other drive member 66. This shaft 60 drives sprockets 68 of the drive means 73 and the drive is transmitted through chain drive 70 to sprocket 69 and shaft 43, through which the drive is transmitted to sprocket 49 within the housing 40. The chain drive 56 transmits the drive from sprocket 69 to sprockets 54 and 55 which are mounted on the same shaft 48 and thence through chain drive 57 to sprocket 51 mounted on shaft 45. The rotation of shaft 45 causes the shaft 66 at the other drive member and its associated sprocket 67 to rotate and provide the drive to the machinery to be driven.

Now the ratio between the speeds of the drive members 60, 66 depends upon (a) the numbers, which are different, of teeth on the two sprockets 68, 69 of the drive means 73, and the orientation of the drive means 73 since it may be mounted with either sprocket 68 or 69 being driven by the shaft 60 of the one drive member, (b) the number of teeth on the sprocket of whichever of the shafts 43 to 48 is selected to be engaged by drive means 73 and the number of teeth on the sprocket on whichever of the shafts 43 to 48 which is selected to be engaged with the other drive member, shaft 66. Since all of the shafts 43 to 48 are capable of acting as driven shafts or driving shafts in this context and since each bears a sprocket of differing size it will be readily appreciated that a very large number of input/output speed ratios is possible with this device. This may be enlarged even further by having a number of different drive means 73 incorporating sprockets of different tooth ratios.

WHAT WE CLAIM IS:—

1. A machine comprising two drive members and a transmission device releasably attached to said machine and arranged to transmit power between said drive members, said transmission device comprising a housing, a series of at least two rotary elements mounted in said housing on a pitch circle about one of said drive members and interconnected for simultaneous rotation together, both said drive members being disposed at one side of the housing but with said one drive member extending through said housing from said one side to the other side of said housing, a drive means engaged with said one drive member at said other side of said housing, said drive means being rotatably mounted at said other side of said housing for movement relative to said housing about said one drive member for engagement with any one of at least two of said rotary elements, said housing with said rotary elements being rotatable relative to the other of said drive members about said one drive member for the engagement of any one of at least two of said rotary elements with said other drive member at said one side of said housing, at least one of said rotary elements being engageable with said drive means and with said other drive members.

2. The device as claimed in claim 1 wherein said rotary elements are mounted in said housing for rotation about axes parallel to one another and passing through said pitch circle, said other drive member being mounted for rotation about an axis parallel to said axes of rotation of said rotary elements and passing through said pitch circle.

3. The device according to claim 2 wherein engagement between the other drive member and one of the rotary elements is by way of a shaft non-rotatable relative to both the other drive member and that one rotary element.

4. The device according to claim 3 wherein each of the rotary elements is formed with a non-circular axially extending hole for engagement by the shaft.

5. The device according to any one of claims 1 to 4 wherein the one drive member is located on the axis of the pitch circle.

6. The device according to claim 5 wherein the drive means is movable about the axis of the pitch circle relative to the other drive member and to the rotary elements for the engagement of the drive means with a selected one of the rotary elements.

7. The device according to claim 6 wherein the axis of rotation of the one drive member is coincident with the axis of the pitch circle.

8. The device according to claim 7 wherein the drive means comprises two rotary members interconnected for simultaneous rotation together.

9. The device according to claim 8 wherein the axis of rotation of one of the rotary members is coincident with the axis of rotation of the one drive member.

10. The device according to claim 9 wherein the one drive member comprises a shaft and the one of the rotary members is mounted on that shaft non-rotatably relative to that shaft.

11. The device according to claim 9 or claim 10 wherein the axis of rotation of the other rotary member is parallel to that of the one rotary member and extends through the pitch circle.

12. The device according to claim 11 wherein the engagement between the drive means and one of the rotary elements comprises a shaft connected non-rotatably between the other rotary member and that one of the rotary elements.

13. The device according to claim 12 as dependent upon claim 10 wherein the housing comprises a bearing in which is journalled the shaft of the one drive member, the housing being pivotable about that shaft.

14. The device according to claim 12 as dependent upon claim 10 wherein the rotary members of the drive means rotate at different speeds and have axial holes of the same shape and dimensions whereby they are interchangeable the one with the other on the shaft of the one drive member and the shaft which is non-rotatable with the one rotary element.

15. The device according to claim 8 or any one of claims 9 to 14 dependent on claim 8 wherein the rotary members are meshing gears.

16. The device according to any one of the preceding claims wherein the rotary elements are meshing gears.

17. The device according to any one of the preceding claims wherein the drive means is readily detachable from the housing and replaceable by another drive means.

18. The device according to any one of the preceding claims wherein the machine is a seed drill.

19. A transmission device substantially as described herein with reference to and as shown in Figures 1 to 4 of the accompanying drawings.

20. A transmission device substantially as described herein with reference to and as shown in Figures 5 to 8 of the accompanying drawings.

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Sheet 1

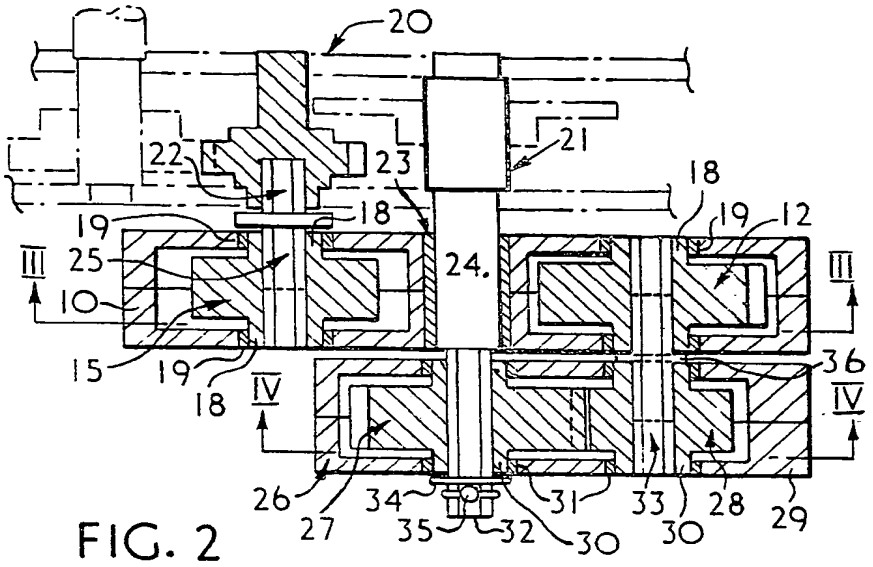


FIG. 2

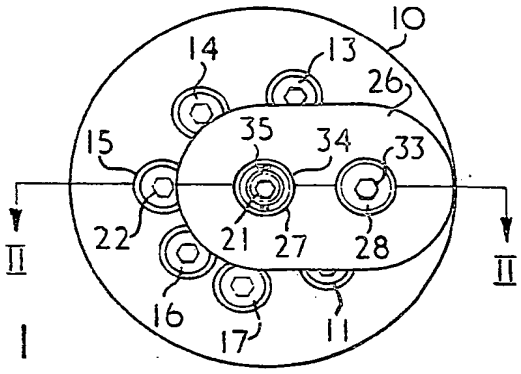


FIG. 1

FIG. 3

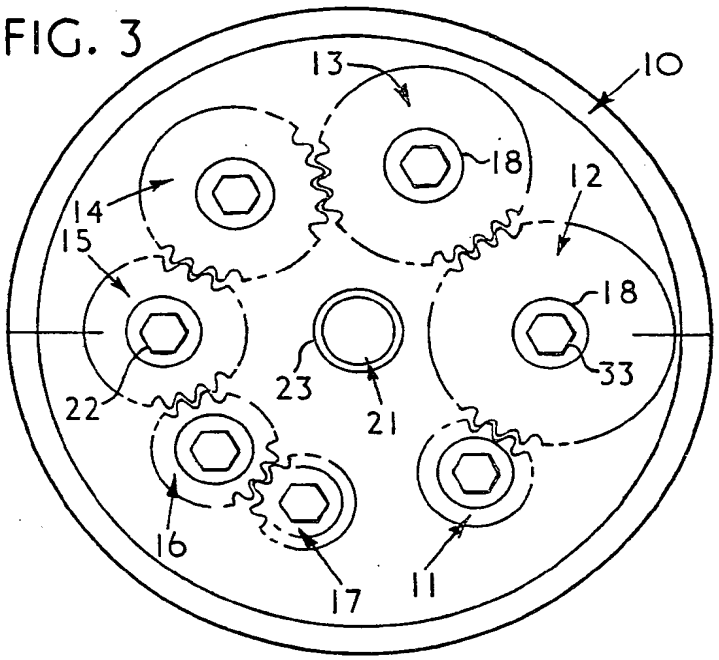
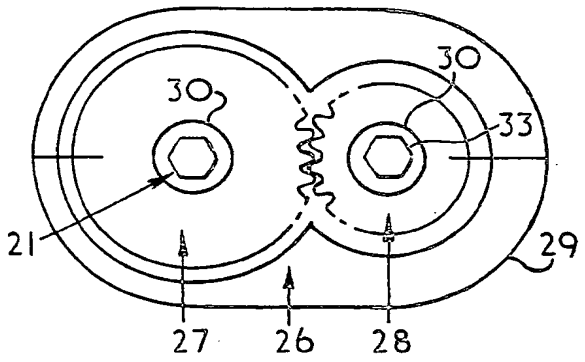


FIG. 4



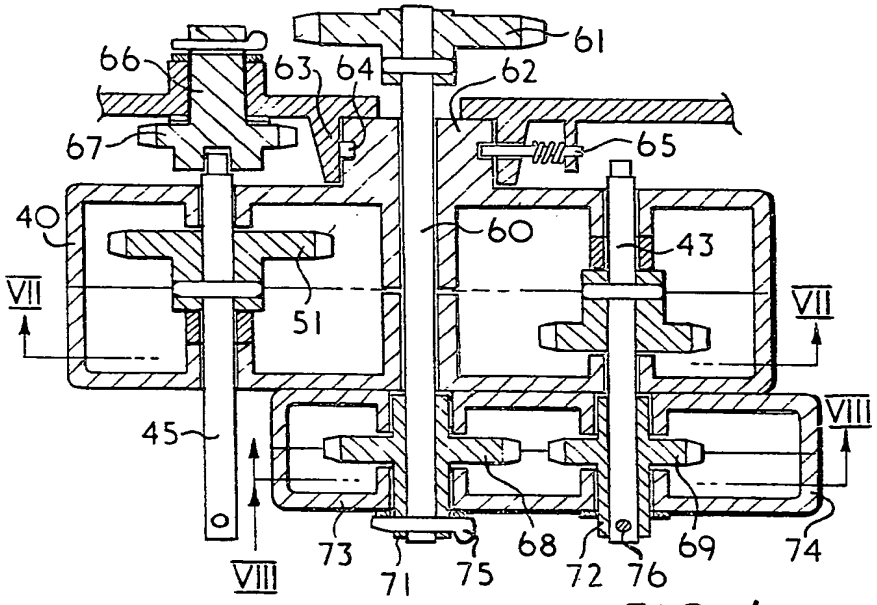


FIG. 6

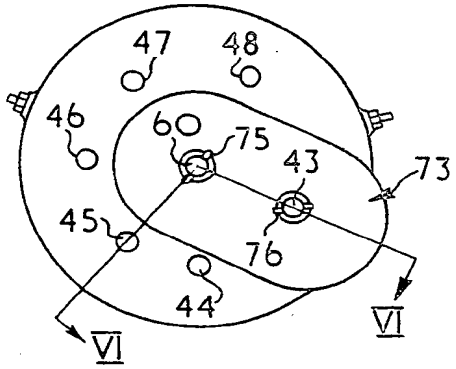


FIG. 5

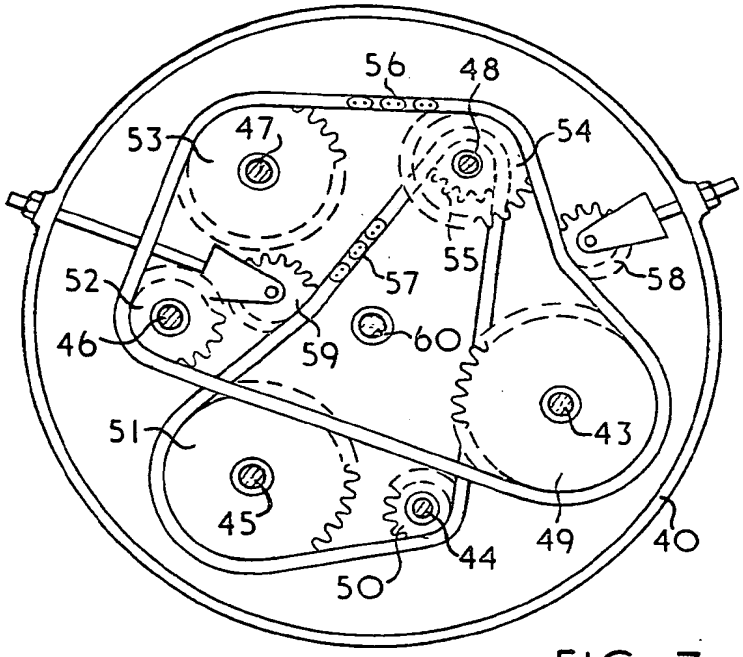


FIG. 7

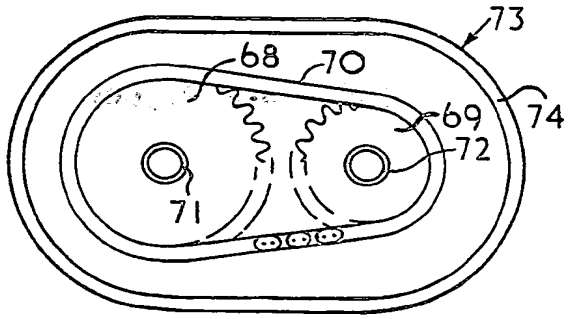


FIG. 8

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